Liza M. Walsh
Christine I. Gannon
CONNELL FOLEY LLP
85 Livingston Avenue
Roseland, New Jersey 07068-1765
Tel.: (973) 535-0500
Fax: (973) 535-9217

Attorneys for Plaintiff
TransWeb, LLC

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF NEW JERSEY

TRANSWEB, LLC, Plaintiff and Counterclaim-Defendant, v. 3M INNOVATIVE PROPERTIES COMPANY and 3M COMPANY, Defendants and Counterclaim-Plaintiffs.	CIVIL ACTION NO. 10-04413 (FSH/PS) **CERTIFICATION OF CHRISTINE I. GANNON IN SUPPORT OF OPPOSITION TO 3M'S MOTION TO EXCLUDE TESTIMONY OF DR. BRADLEY N. REIFF** ***Electronically Filed*** **Return Date: March 19, 2012**

I, Christine I. Gannon, certify as follows:

1. I am an attorney at law at Connell Foley LLP and am an admitted to practice before the court, and am counsel of record for the Plaintiff, TransWeb, LLC ("TransWeb"), in the above matter. I submit this Certification in support of TransWeb's Opposition to Defendants 3M Innovative Properties Company and 3M Company's ("3M") Motion to Exclude Testimony from Dr. Bradley N. Reiff.

2. Attached hereto as Exhibit A is a true and correct copy of a 1998 article written by Leonard W. Barrett and Alan D. Rousseau entitled "Aerosol Loading Performance of Electret Filter Media."

3. Attached hereto as Exhibit B is a true and correct copy of a spreadsheet produced in discovery by TransWeb bearing the Bates number TW0062790.

4. Attached hereto as Exhibit C is a true and correct copy of Dr. Bradley N. Reiff's list of "Materials Considered," served February 1, 2012.

I certify under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Dated: March 5, 2012

Christine I. Gannon

EXHIBIT A

AMERICAN INDUSTRIAL HYGIENE ASSOCIATION JOURNAL 59:532–539 (1998) Ms. #799

THEORETICAL & EXPERIMENTAL STUDIES

AUTHORS
Leonard W. Barrett
Alan D. Rousseau

3M Company, Occupational Health and Environmental Safety Division, 3M Center, 260-3B-08, St. Paul, MN, 55144-1000

Aerosol Loading Performance of Electret Filter Media

In this study various types of flat sheet electret filter media including tribocharged polypropylene/acrylic, corona charged polypropylene, fibrillated electret film, and new advanced electret media have been compared with mechanical filter media (fiber glass) using aerosol filtration tests designed for particulate respirators. The number of layers, and thus the total mass and pressure drop, of the media were varied while the filter area exposed to the aerosol and the aerosol flow rate was held constant (constant face velocity). Tests included challenges with sodium chloride and dioctyl phthalate (DOP) aerosols per NIOSH 42 CFR 84 specifications for particulate respirator certification. Initial filtration efficiency and pressure drop and the same during loading were determined. Results revealed significant differences in filtration performance and loading behavior among the various media. It is concluded that respirators can be designed for all nine 42 CFR 84 classes using electret filter media without sacrificing low pressure drop, light weight, or user comfort.

Keywords: electret filter media, electrostatic, respirators

Fibrous electret filter media have been used in particulate respirators for many years. The electrostatic charge on electret filter media enhances the filtration efficiency over that of purely mechanical filters. The enhanced efficiency results in an electret filter with less breathing resistance (lower pressure drop) than a mechanical filter with the same efficiency and surface area. Respirators utilizing electret filter media can generally be made lighter in weight and more compact than those made from mechanical filter media. Therefore, electret filter media is especially suited to filtering facepieces. However, the efficiency of electret filter media can be reduced by exposure to certain aerosols;[1–5] mechanical filters are generally more resistant to this type of efficiency loss.

Recently a new NIOSH regulation for respiratory protection devices, 42 CFR 84, became law. The filter test method required by 42 CFR 84 for negative pressure respirator certification specifies minimum filtration efficiencies during loading of the respirator with a specified amount of most penetrating-size particles of solid sodium chloride aerosol or oily liquid dioctyl phthalate (DOP) aerosol. These loading tests have been shown to decrease the filtration efficiency of certain types of electret media.

Liquid aerosols from oils such as DOP with a relatively high dielectric constant can decrease the filtration efficiency of electret filters. Liquids generally do not form a filter cake, as do solid particulates. Formation of a filter cake increases the efficiency of mechanical filtration.[5] Filter caking can have a significant effect on filtration for relatively fine fiber electret filter media when challenged by solid particulate aerosols.

Possible mechanisms for loss of filtration efficiency of electrostatic filters caused by certain aerosols are discussed by Brown[2] and include the following:

(1) neutralization of the charge on the fiber by opposite charges on the captured aerosol particles,

(2) screening of the fiber charge by a layer of captured particles, and

(3) disruption of the charge-carrying part of the fiber by the aerosol, either by dissolution of the surface layer or by chemical reaction.

Tennal et al.[3] suggest that ionic conduction through an oil film on the fiber due to deposited droplets causes discharge of the electrets when liquid aerosols are involved.

Blackford et al.[4] tested seven industrial aerosols including coal dust, foundry fettling fume, foundry burning fume, carbon brick dust, lead smelting fume, lead battery dust, and ammonium chloride. Four different types of electrostatic material were used in the investigation: resin-wool,[6] large fibers made from fibrillated electret

TABLE I. Types of Filter Media Tested and Properties of a Single layer

Filter Media Type	Basis Weight (g/m²)	Thickness (mm)	Pressure Drop mmH_2O @ 7.8 cm/sec	Effective Fiber Diameter[11] (μm)
Fiber glass (several types tested)	60–95	0.5–0.7	6–55	1–3
Tribocharged polypropylene/acrylic	150	3.2	0.8	31
Fibrillated polypropylene film	100	2.4	0.7	22
Electrostatic charged polypropylene BMF	60	0.9	3.2	8
N-type advanced electret	60	0.9	3.0	8
R-type advanced electret	60	0.9	2.8	8
P-type advanced electret	60	1.0	3.8	7

film,[7] and electrostatically spun material including a polycarbonate material produced from a solution[8] and a polypropylene material produced from the melt.[9] They reported increasing penetration with aerosol loading in all cases for all filter types.

Tennal et al.[3] tested a spun-type electret filter using monodisperse bis-ethylhexyl sebacate liquid aerosols with zero charge and with an equilibrium charge distribution. The loading estimated to discharge the filter completely was calculated by assuming that each collected charge neutralized one charge of opposite polarity on the fibers of the filter. When the calculated results were compared with the experimental results, it was found that the calculation significantly underestimated the effect of the aerosol (by almost three orders of magnitude). It was also determined that there was no difference between the effect of loading with equilibrium charge droplets and zero charge droplets. Based on these results they concluded that direct neutralization of the fiber charges by charged aerosol is not the mechanism responsible for the reduction in filter efficiency with loading.

Whatever the mechanism, the potential reduction in filtration efficiency of electret filter media by the aerosols they filter is a concern to those responsible for respiratory protection. In the current study traditional and advanced electret filter media were tested with sodium chloride and DOP aerosols using the most penetrating particle size as specified in the respirator certification tests in 42 CFR 84.[10]

MATERIALS AND METHODS

The chosen filter materials were typical of those used in commercially available particulate respirators. The general classes of materials tested and properties measured on a single layer of material are listed in Table I. Fiber glass filter media of varying fiber size and weight were purchased from Hollingsworth & Vose of West Groton, Mass. Tribocharged polypropylene/acrylic was obtained from All Felt Products, Inc. of Ontario, Calif., sold under the Technostat trade name. Fibrillated electret polypropylene film, electrostatically charged polypropylene blown microfiber (BMF), and advanced electret media (AEM), a new class of filter media developed by 3M of St. Paul, Minn., were all produced by 3M and included in this study.

The filter materials of Table I were tested as flat samples using a 6-inch diameter circular face area, at an aerosol flow rate of 85 L/min, following the test protocol specified by NIOSH for 42 CFR 84 respirator certification.[12,13] The area chosen for these tests is close to the area of most commercially available filtering facepiece respirators, so that respirator behavior should be similar to that of the flat sheets. Two tests are used for certifying particulate respirator filter material under 42 CFR 84. For N-series particulate respirators, the maximum sodium chloride aerosol penetration during a 200-milligram loading test is specified. For R-series, the maximum DOP penetration during a 200-milligram loading test is determined, and for P-series it is further required that the DOP penetration must not be increasing at the end of the test. A TSI (St. Paul, Minn.) model 8130 automated filter tester was used for the N-series sodium chloride aerosol loading test, and a TSI model 8110 automated filter tester was used for the DOP aerosol loading test. Test conditions are outlined in Table II.

Additional samples of the filter materials were tested using multiple layered combinations. At least three different layered combinations, typically 1, 2, and 3 layers, were tested in triplicate to achieve a range in pressure drop and thickness. For each test both aerosol penetration and pressure drop were recorded as a function of the mass of aerosol challenged to the filter, to produce what is herein called a loading curve. The sodium chloride test typically lasted more than 2.5 hours for each sample, due to the low aerosol concentration, while the DOP test was normally completed in less than 30 minutes for each sample.

It should be emphasized that these tests were performed on flat samples of filter material using a constant surface area, and not on respirators. The area chosen in these tests is similar to that of most filtering facepiece respirators; however, results of testing on respirators may or may not be analogous, depending on the particular respirator design and filter construction.

TABLE II. Summary of Test Conditions Used

Test Condition	NaCl Aerosol Test (for N-series)	DOP Aerosol Test (for R- and P-series)
Instrumentation	TSI AFT model 8130	TSI AFT model 8110
Filter size	6″ circle (182 cm²)	6″ circle (182 cm²)
Aerosol material	sodium chloride (solid)	dioctyl phthalate (oily liquid)
Aerosol flow rate	85 L/min	85 L/min
Aerosol face velocity	7.8 cm/sec	7.8 cm/sec
Aerosol particle size (count median diameter)	0.08 μm	0.18 μm
Aerosol particle size (mass median diameter)	0.2 μm	0.3 μm
Aerosol concentration	15 mg/m³	100 mg/m³
Aerosol challenge	200 mg	200 mg

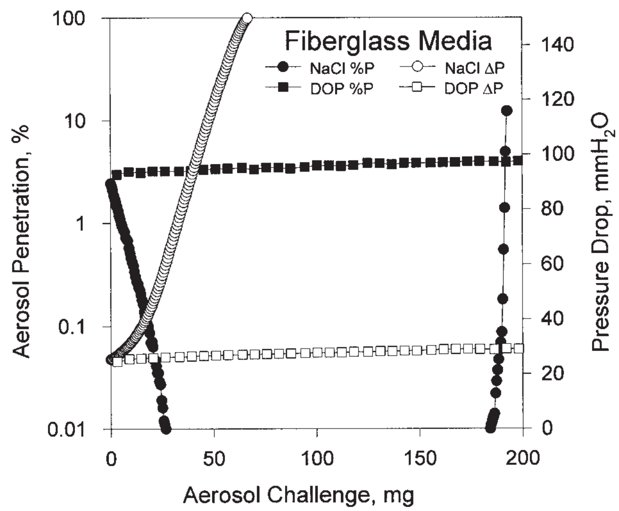

FIGURE 1. Example of DOP and NaCl aerosol loading curves for flat fiber glass filter media (shown are curves for two layers of 2 μm diameter fiber size, 65 g/m² fiber glass).

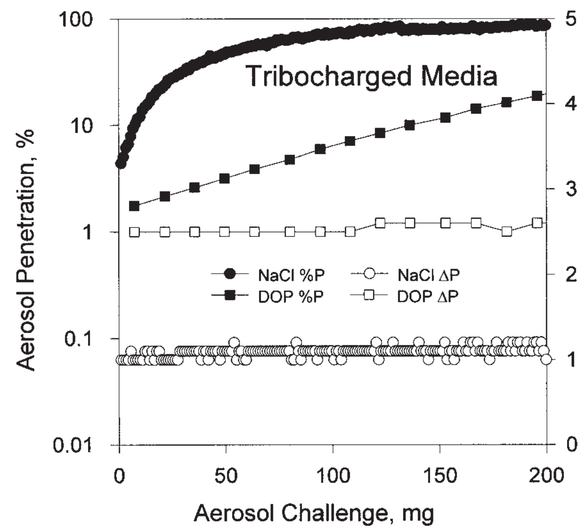

FIGURE 2. Example of DOP and NaCl aerosol loading curves for flat tribocharged filter media (shown are curves obtained from testing a single layer for NaCl, and two layers for DOP, of 150 g/m² material).

RESULTS

Typical DOP and NaCl loading curves for fiber glass media are shown in Figure 1 for two layers of medium with 2 μm diameter fiber size and 65 g/m² basis weight. With DOP loading, a relatively constant penetration versus loading was observed, but it increased from about 3% initially to 4% penetration during the test. Pressure drop increased about 15% during the typical fiber glass media DOP test. With sodium chloride loading, the penetration rapidly decreased while the pressure drop rapidly increased. This is due to filter caking, where the solid particles build up on the surface of the media and contribute to the filtration by enhancing the mechanical filtration mechanisms while also increasing pressure drop.[14] During the test depicted in Figure 1 the pressure drop actually increased to the point that the fiber glass burst apart, as seen by the final dramatic increase in penetration. Because of this, fiber glass media as used in respirators normally require greater filter areas, accomplished by pleating. By using greater filter area, the aerosol face velocity and effective surface loading rate is significantly reduced, resulting in lower pressure drop and penetration.

Tribocharged filter media are produced by processing a blend of fibers that have a large triboelectric potential difference. The fibers are brushed against each other, resulting in charged fiber surfaces.[15] Tribocharged filter media are generally composed of large diameter fibers, which also tend to have a high level of electrostatic charge. The material is very thick and fluffy compared with fiber glass, and has a much lower pressure drop at any given penetration level. Typical loading curves for tribocharged filter media are shown in Figure 2 (shown are curves obtained for a single layer for NaCl, and two layers for DOP, of 150 g/m² material). During the 200-milligram DOP loading test, penetration typically increased an order of magnitude, in this case from an initial penetration of about 2% to 20%, while pressure drop remained essentially constant. This type of medium relies heavily on electrostatic charge enhancement for filtration, and because the collected oil aerosol particles mitigate the electrostatic charge, penetration continually increases with loading. Similar behavior is observed with sodium chloride loading; penetration also rapidly increases, in the case shown to more than 80%, while pressure drop remains constant. Because these large fiber, fluffy media do not form a filter cake, the pressure drop does not change much with loading, so it is well-suited for furnace or other ventilation filters where a rise in pressure drop is undesirable.

Fibrillated electret film media are produced by creating a surface charge on a film made of highly oriented plastic, then breaking the film into fibers and creating a fibrous web (fibrillation).[7] The filtration behavior of fibrillated electret film media is similar to that of tribocharged media, as may be seen in comparing Figure 3 with Figure 2. The fibrillated electret film of Figure 3 had lower basis weight than the tribocharged media of Figure 2, 100 g/m² versus 150 g/m², yet exhibited slightly lower penetration and significantly lower pressure drop. Even at the lower basis weight, the fibrillated electret film is less affected by NaCl loading than the tribocharged media. Both fibrillated electret film and tribocharged media have large fiber size and high electric charge. Again, because caking occurs only very slowly, pressure drop remains relatively constant with particle loading, while penetration rapidly increases.

Electrostatically charged polypropylene blown microfiber, or conventional BMF, is widely used for filtering facepiece respirators. This filter medium is produced by extruding polypropylene through a multiorifice die to form fibers while also blowing the molten fiber stream out of the die and onto a collector with high-pressure air.[16] The BMF may be electrostatically charged by numerous methods.[17] Typical loading curves obtained for conventional BMF are shown in Figure 4 (results from two layers of 60 g/m² material shown). On exposure to oily liquid DOP aerosol, the BMF exhibited an increase in penetration from about 2% initially to 10%, a smaller increase than for the large fiber media previously discussed, but significantly more than fiber glass. With

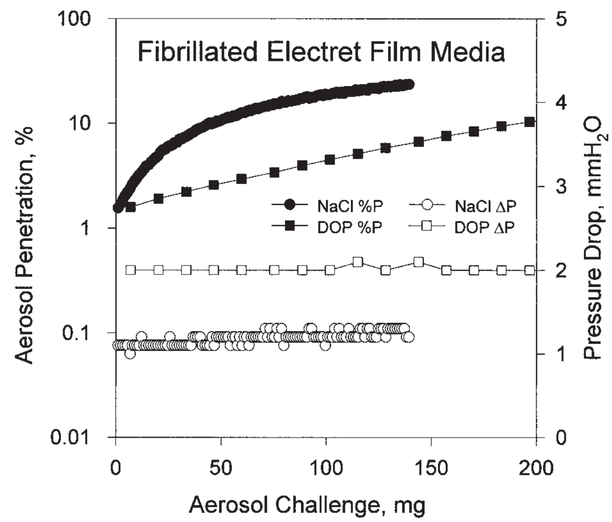

FIGURE 3. Example of DOP and NaCl aerosol loading curves for flat fibrillated electret film filter media (shown are curves obtained from testing a single layer for NaCl, and two layers for DOP, of 100 g/m² material).

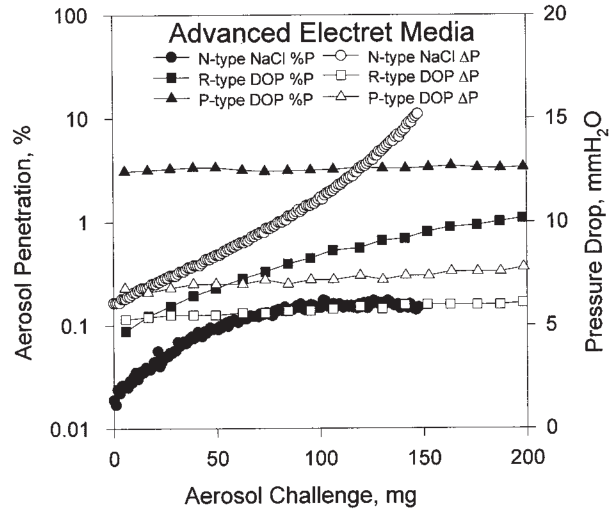

FIGURE 5. Example of DOP and NaCl aerosol loading curves for flat advanced electret filter media (shown are curves obtained from testing two layers of 60 g/m² N-type media for NaCl, and two layers of 60 g/m² R-type and P-type media for DOP).

solid sodium chloride particle loading, a filter cake formed on the BMF, so that penetration decreased with loading, similar to fiber glass, but the cake formed more slowly, resulting in a more gradual increase in pressure drop. Overall, electrostatically charged BMF has characteristics between that of fiber glass, which has very small diameter fibers and essentially no electric charge, and tribocharged or fibrillated electret film media, that have large diameter fibers and high electric charge.

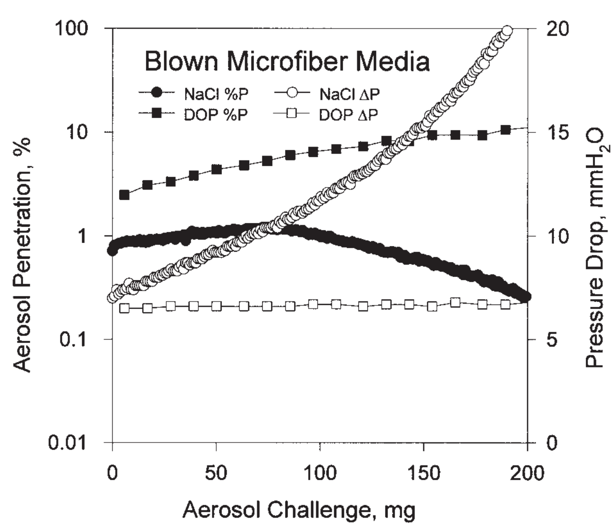

FIGURE 4. Example of DOP and NaCl aerosol loading curves for flat conventional blown microfiber filter media (shown are curves obtained from testing two layers for both NaCl and DOP, of 60 g/m² material).

Over the past several years, 3M has developed technologies to improve the filtration characteristics of electrostatically charged BMF in both solid aerosol and oily mist environments. Loading curves obtained from two layers of 60 g/m² material are shown in Figure 5 in which filter media were designed for N, R, or P performance criteria. By increasing both the DOP resistance and level of electrostatic charge on the fibers, media suitable for NIOSH 42 CFR 84 R-series may be produced that have low pressure drop at a given DOP penetration level. The trade-off for this high-efficiency medium is increasing penetration with DOP loading. In the example shown in Figure 5, the loading behavior is similar to conventional electrostatically charged BMF, but with at least 10 times lower penetration at about the same pressure drop. Alternatively, by providing resistance to DOP and adjusting the charge level, media may be made that is suitable for the P-series of respirators, where constant or decreasing penetration during DOP loading is required. The loading curve for a P-type medium is shown in Figure 5 and is actually flatter than that for the fiber glass media previously shown, but with less than one-third the pressure drop at the same penetration. The trade-off for the flat P-type loading performance is greater pressure drop than the R-type media.

Like most other media, the R- and P-type media are actually more efficient filters of solid aerosols than oily liquids; however, for solid aerosols, even more advantage in pressure drop can be obtained through further charge level optimization. In the example of Figure 5, media were developed for NIOSH 42 CFR 84 N-series of respirators and were tested against sodium chloride aerosol. Compared with conventional BMF, the pressure drop versus loading curves are nearly identical, but with the new N-type media, filter penetration is an order of magnitude lower at the same pressure drop and has from 10 to 35 times lower penetration than conventional electrostatically charged BMF.

After collecting multiple loading curves and assembling data from numerous layered combinations of a single type of filter medium, performance curves may be obtained in which penetration,

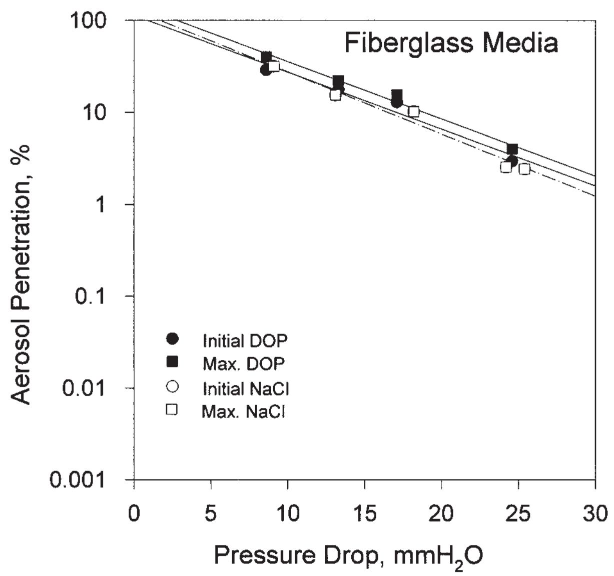

FIGURE 6. Pressure drop and penetration performance for DOP and NaCl aerosols for flat fiber glass filter media

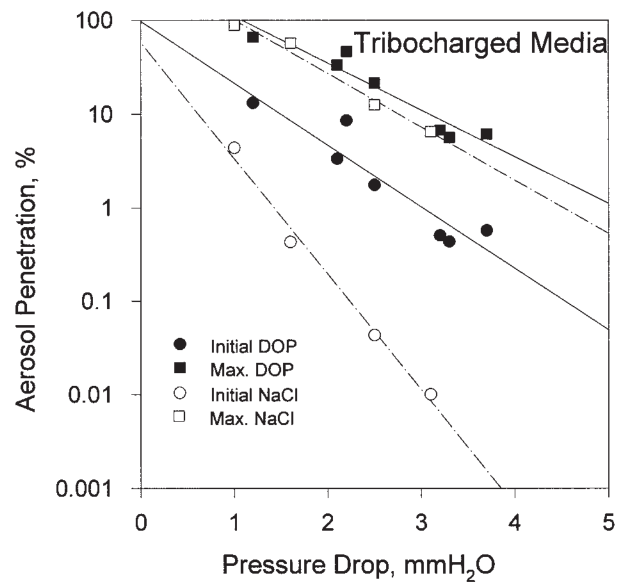

FIGURE 7. Pressure drop and penetration performance for DOP and NaCl aerosols for flat tribocharged filter media.

either initial or maximum during the loading test, may be plotted against another filter parameter such as pressure drop, thickness, or mass. While the loading curve indicates the behavior of a filter as it collects aerosol particles, the performance curve indicates the utility of that type of filter medium for providing a penetration level at a given pressure drop, thickness, or mass.

The first set of performance curves is shown in Figure 6, in which initial and maximum DOP and NaCl penetration are plotted against pressure drop for fiber glass media. In this type of plot, for the media indicated, one could predict the pressure drop and penetration of a filter as indicated by the fitted lines, as long as the same area is used (182 cm² in the case of this study). Higher performance filter media would have fitted lines with greater downward slope, or lower pressure drop at any given penetration. Increasing the filter area would shift the curve toward higher performance, with lower penetrations at all pressure drops. For the sodium chloride test the initial and maximum penetrations are the same, with data points falling on top of one another, which follows from the NaCl loading behavior observed in Figure 1. Since the DOP penetration was observed to rise slightly during the loading test, initial and maximum DOP performance are slightly different. In general, because of the lack of significant electrostatic charge, fiber glass media has poor filtration performance. For example, if a filter were to achieve 5% maximum DOP penetration, corresponding to a P95 respirator, using flat fiber glass media, the pressure drop would be at least 25 mmH$_2$O, barely acceptable by 42 CFR 84 standards, and surely higher than what most users would find comfortable (using the 182 cm² filter area). For this reason fiber glass must be pleated to extend the filter area, and packaged in cartridges due to its fragility.

The pressure drop performance curves shown in Figure 7 depict results for tribocharged media. Comparing this data with that for fiber glass media, much greater filtration performance is apparent from the pressure drop scaling on the x-axis. The large difference between initial and maximum penetrations is the result of the loading behavior shown in Figure 2. With the particular media tested in this study, the maximum DOP and NaCl penetrations were very close at all pressure drops. It is widely held that DOP aerosol is more penetrating than NaCl aerosol.[3] NIOSH 42 CFR 84 regulations incorporate this belief, since R-series respirators, tested against DOP, are assumed to be able to pass requirements for N-series respirators, tested against NaCl. Using the tribocharged filter media tested, however, it is possible to construct a respirator that would pass R95 requirements, but not N95.

Pressure drop performance curves for fibrillated electret film media are shown in Figure 8. In general, the observed performance was better than that of tribocharged media. Both media have large fibers and high electrostatic charge. The major difference was the distinction between DOP and NaCl behavior. The fibrillated film had significantly better performance than the tribocharged material during loading with NaCl.

In Figure 9, pressure drop performance for conventional blown microfiber electret filter media is shown. It may be seen that with BMF, DOP is always more penetrating; and in the 1% to 10% range, the maximum NaCl penetration is about the same as the initial DOP penetration. The penetration/pressure drop performance of this type of media is between that of the large fiber, high electric charge media and fiber glass.

In Figure 10, pressure drop performance for various types of advanced electret media is depicted. For P-type media, the initial penetration is also the maximum value, so only a single DOP performance curve is shown. The only media acceptable for the P-series of respirators would be P-type media (Figure 10) and fiber glass (Figure 6). Comparing the two, P-type media have less than one-third the pressure drop of fiber glass at any penetration level. In comparing media for the R-series, conventional BMF (Figure 9) has higher pressure drop, about twice as high as R-type media (Figure 10) or tribocharged or fibrillated electret film media (Figures 7 and 8). For the N-series, conventional BMF (Figure 9)

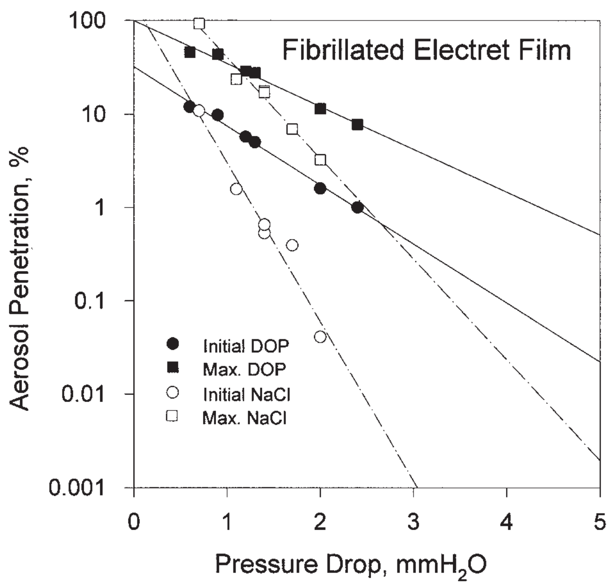

FIGURE 8. Pressure drop and penetration performance for DOP and NaCl aerosols for flat fibrillated electret film filter media

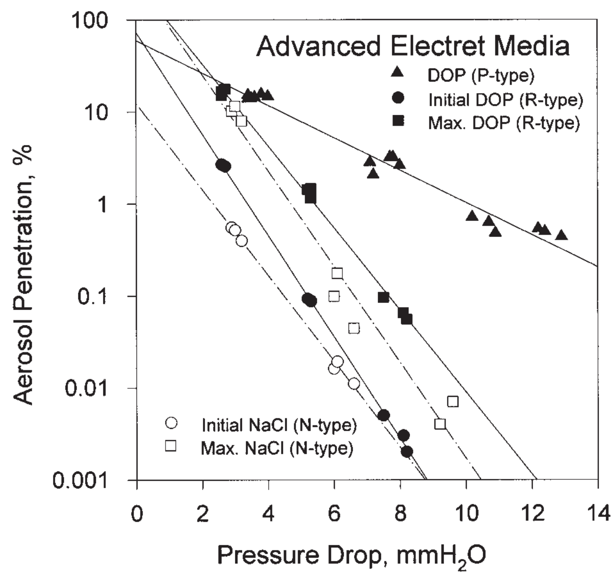

FIGURE 10. Pressure drop and penetration performance for DOP and NaCl aerosols for flat advanced electret filter media

again has pressure drop typically twice as high as N-type media (Figure 10) or tribocharged or fibrillated electret film media (Figures 7 and 8).

While the new R-type and N-type advanced electret media do not differ significantly from large fiber media in terms of pressure drop and penetration, they are very different in terms of the thickness required to reach a given penetration level. Shown in Figure 11 are thickness performance curves, in which penetration is plotted versus media thickness. The large diameter fiber media, both tribocharged and fibrillated electret film, are very thick in comparison with all of the advanced electret media. For example, at a maximum DOP penetration of 5%, corresponding to an R95 respirator, the tribocharged media would require a thickness of about 10 mm, compared to only 1.5 mm for the R-type BMF. The

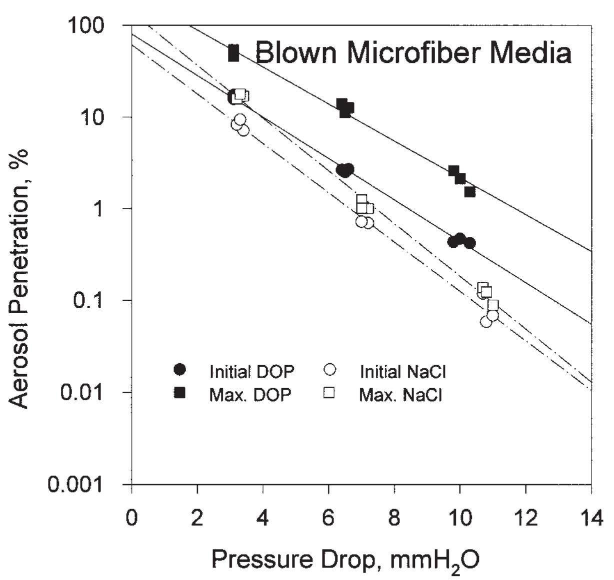

FIGURE 9. Pressure drop and penetration performance for DOP and NaCl aerosols for flat conventional blown microfiber filter media

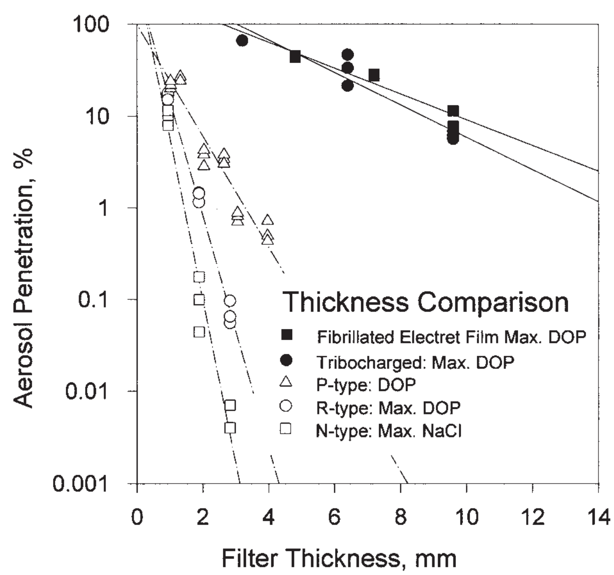

FIGURE 11. Thickness and penetration performance for DOP and NaCl aerosols for selected filter media

significance for the respirator user is that a product made with R-type BMF will be thinner, lighter, and potentially more comfortable.

DISCUSSION

To distinguish the seven types of filter media evaluated in this study, it is useful to characterize important properties. Fiber diameter is a very important feature of fibrous filters, and the fiber glass media had the smallest fibers of those tested; tribocharged and fibrillated film media had the largest fibers; and the blown microfiber media and advanced electret media were of intermediate fiber diameter. The differences in fiber diameter, coupled with the filter density, affect the tendency of the media to form a filter cake with solid aerosols. As a result, fiber glass (small fiber and high density) immediately cakes, BMF and AEM cake more slowly, and tribocharged and fibrillated electret film media (large fiber and low density) do not readily cake. For a motorized room air filter, a constant pressure drop with loading is an advantage. For a respirator, however, if penetration increases while pressure drop remains constant, the user may have no warning as the filter efficiency decreases.

The fiber diameter also directly relates to the media pressure drop and mechanical filtration mechanisms. A filter medium composed of larger diameter fibers relies more heavily on electrostatic charge for filtration efficiency. The magnitude of electrostatic charge has a great effect on loading behavior and performance. Increasing the level of electrostatic charge improves filtration performance in terms of initial penetration, but a higher charge also leads to more rapid penetration increase with aerosol loading. Thus, fiber glass media, with essentially no electrostatic charge, has low performance but very constant penetration with DOP aerosol loading; fibrillated electret film and tribocharged media, with high charge levels, have excellent initial performance but rapidly increasing penetration with loading; and BMF and advanced electret media, with moderate charge level, can have very good performance and flat or moderately increasing penetration with aerosol loading.

The lack of resistance to DOP loading in electrostatic filters has been identified in the past. The oily liquid aerosol droplets can spread over fiber surfaces, reducing the filtration enhancement from electrostatic charge, resulting in increasing penetration as a function of loading.[3] With recent advances in electret filter media, oily mist loading can exhibit the same behavior as fiber glass mechanical filters with essentially no change in penetration. Such filter media is especially well-suited for the new NIOSH P-series of respirators.

CONCLUSION

In this research study it was observed that media without electrostatic charge has much lower filter performance, in terms of pressure drop at a given penetration level, than media that includes an electrostatic charge. For this reason, purely mechanical media, such as fiber glass, must generally be pleated to extend surface area and improve performance. In general, electrostatically charged filter media with large diameter fibers, such as tribocharged media or fibrillated electret film media, exhibited excellent initial filtration performance. However, when these media are loaded with aerosol particles, the penetration increases dramatically, with very little change in pressure drop.

Smaller fiber electrostatic media, such as conventional electrostatically charged BMF, have initial filter performance better than uncharged media, but generally not as good as large fiber media. With this smaller fiber media, solid aerosols can form a filter cake, causing penetration to decrease, while pressure drop increases with loading. With oily liquid aerosols, performance is similar to large fiber media, where penetration increases while pressure drop remains constant; however, the increase in penetration is less dramatic.

Using new electrostatically charged BMF technology, small fiber media can be made with improved resistance to oily liquid aerosols and greater levels of filtration enhancing electrostatic charge, leading to filters with much lower pressure drop than fiber glass media but with equal penetration and flat loading behavior, and pressure drop performance commensurate with the best large fiber media, while being thinner and lighter.

Significant differences exist among electrostatic filters in use today, with some media better suited for respirators than others. Generalizations cannot be made about the class as a whole. Conventional electrostatic media may suffer a loss in efficiency after extended exposure to certain aerosols, especially oily mist aerosols such as DOP. However, newer technology electrostatic media with higher electrostatic charge level and oily mist resistance exhibit improved overall filter efficiency while also eliminating efficiency loss due to aerosol loading. By taking advantage of this advancement in filter technology, respirators may be designed with media optimized for all NIOSH certification classes and types of aerosol challenges.

REFERENCES

1. **Baumgartner, H.P., and F. Loffler:** The Collection performance of electret filters in the particle size range 0.01 μm–10 μm. *J. Aerosol Sci. 17*:438–445 (1986).
2. **Brown, R.C.:** The behaviour of fibrous filter media in dust respirators. *Ann. Occup. Hyg. 23*:367–380 (1980).
3. **Tennal, K.B., M.K. Mazumder, A. Siag, and R.N. Reddy:** Effect of loading with an oil aerosol on the collection efficiency of an electret filter. *Particulate Sci. Technol. 9*:19–29 (1991).
4. **Blackford, D.B., G.J. Bostock, R.C. Brown, R. Loxley, and D. Wake:** Alteration in the performance of electrostatic filters caused by exposure to aerosols. Paper presented at the 4th World Filtr. Congr., Royal Flemish Society, Belgium, 1986.
5. **Brown, R.C.:** *Air Filtration.* New York: Pergamon Press, 1993. pp. 234–236.
6. **Feltham, F.J.:** The Hansen filter. *Filtration and Separation 16*:370–372 (1979).
7. **Turnhout, J. van, C. van Bochove, and G.J. van Veldhuizen:** Electret fibres for high-efficiency filtration of polluted gases. *Staub 36(1)*: 36–39 (1976).
8. **Schmidt, K.:** Herstellung und anwendung feinstfaservliesen im filterbereich.[Production and applications of nonwovens composed of extremely fine fibers in filter systems.] *Melliand Textilberichte 6*:495–497 (1980).
9. **Trouilhet, Y.:** New method of manufacturing nonwovens by electrostatic laying. In *Advances in Web Forming, Congress Papers, Amsterdam, Index 81, Session 3*: European Disposables and Nonwovens Association, 1981.
10. "Respiratory Protective Devices; Final Rules and Notice," *Federal Register 60*:110 (8 June 1995) pp. 30336–30404.
11. **Davies, C.N.:** The separation of airborne dust and particles. *Proc. Inst. Mech. Eng. 1B(5)*:185–213 (1952).
12. **National Institute for Occupational Safety and Health (NIOSH):** *Particulate Filter Penetration Procedure to Test Negative Pressure Respirators against Liquid Particulates* (Procedure APRS-STP-0051-00). Morgantown, WV: NIOSH Division of Safety Research, 1995.

13. **National Institute for Occupational Safety and Health (NIOSH):** *Particulate Filter Penetration Procedure to Test Negative Pressure Respirators against Solid Particulates* (Procedure APRS-STP-0057-00). Morgantown, WV: NIOSH Division of Safety Research, 1995.

14. **Novick, V.J., P.R. Monson, and P.E. Ellison:** The effect of solid particle mass loading on the pressure drop of HEPA filters. *J. Aerosol Sci. 23*:657–665 (1992).

15. **Brown, R.C.:** *Air Filtration*. New York: Pergamon Press, 1993. pp. 122–126.

16. **Van Wente, A.:** Superfine thermoplastic fibers. *Ind. Engin. Chem. 48*: 1342–1346 (1956).

17. **Brown, R.C.:** *Air Filtration*. New York: Pergamon Press, 1993. pp. 126–128.

EXHIBIT B

Atomic Concentration Table																Corrected Binding Energies						% of C1s						Area Ratio
																C1s												
Sample	Filename	C1s	N1s	O1s	F1s	Na1s	Al2p	Si2p	P2p	S2p	Cl2p	K2p3	Ca2p	Zn2p3	Sn3d3	C-C	C-C	*C-CFx	CF	CF2	CF3	C-C	C-C	*C-CFx	CF	CF2	CF3	CF3/CF2
Kimberly Clark R95, layer 3	Y0BEK810101	99.9	0.0	0.1	0.0	-	-	-	-	-	-	-	-	-	-													
North 7506R95, layer 2	Y0BEK810111	93.2	1.5	4.7	0.0	-	-	-	0.5	-	-	-	0.2	-	-													
North 7506R95, layer 3	Y0BEK810121	94.7	1.1	3.8	0.0	-	-	-	0.4	-	-	-	0.2	-	-													
Moldex 7940, P100, layer 2B	Y0BEK810131	96.7	0.8	2.5	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 7940, P100, layer 2C	Y0BEK810141	97.9	0.8	1.3	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 8970, R95, layer 2B	Y0BEK810151	90.7	0.9	5.8	0.0	-	-	2.6	-	-	-	-	-	-	-													
Moldex 8970, R95, layer 2C	Y0BEK810161	93.1	3.6	3.3	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 2360, P100, layer 2	Y0BEK810171	93.3	3.4	3.2	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 2360, P100, layer 3	Y0BEK810181	93.3	3.5	3.2	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 2360, P100, layer 5	Y0BEK810191	97.3	0.8	1.9	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 2360, P100, layer 6	Y0BEK810201	92.9	3.8	3.4	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 2941R95, layer 3	Y0BEK810211	94.3	2.9	2.8	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 2941R95, layer 5, side facing layer 9	Y0BEK810221	98.2	0.1	1.7	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 2941R95, layer 5, side facing layer 1	Y0BEK810223	94.5	2.7	2.8	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 2941R95, layer 7	Y0BEK810231	94.8	2.6	2.6	0.0	-	-	-	-	-	-	-	-	-														
MSA-R95, P/N 816285, element 1	Y0BEK810241	35.3	0.1	43.9	0.1	1.3	1.7	16.4	-	-	-	0.4	0.3	0.4	-													
MSA-R95, P/N 816285, element 2	Y0BEK810251	26.7	0.1	52.9	0.1	3.1	1.9	13.8	-	-	-	0.5	0.3	0.6	-													
Drager 882FMP3 R D/P3R/P100	Y0BEK810261	21.3	0.1	54.5	0.1	1.3	1.5	20.4	-	-	-	0.3	0.3	0.1	-													
North 7580P100	Y0BEK810271	46.2	1.2	31.2	11.2	0.4	0.8	9.1	-	-	-	-	0.1	0.0	-		285.2	287.0	289.1	291.6	294.0		65.4	21.8	6.0	5.3	1.5	0.28
North 75FFP100, layer 2	Y0BEK810281	50.1	0.6	2.9	46.2	-	-	0.2	-	-	-	-	-	-	-		285.2	287.4	289.5	291.6	293.7		50.1	17.2	9.7	10.1	12.9	1.27
North 75FFP100, layer 3	Y0BEK810291	47.6	0.5	3.0	48.9	-	-	-	-	-	-	-	-	-	-		285.1	287.2	289.4	291.6	293.6		39.2	21.0	14.0	11.4	14.3	1.25
North 75FFP100, layer 4	Y0BEK810301	45.6	0.4	1.5	52.5	-	-	-	-	-	-	-	-	-	-		284.8	286.8	289.1	291.5	293.5		27.8	24.9	16.3	14.5	16.5	1.14
North 75FFP100, layer 8	Y0BEK810311	44.4	0.5	2.0	53.0	-	-	-	-	-	-	-	-	-	-	283.3	285.1	287.2	289.5	291.7	293.7	2.1	24.2	24.4	17.2	15.0	17.2	1.15
North 75FFP100, layer 10	Y0BEK810321	48.1	0.4	1.4	50.2	-	-	-	-	-	-	-	-	-	-		285.1	287.1	289.3	291.6	293.7		39.3	20.0	13.4	12.0	15.3	1.27
North 75FFP100, layer 11	Y0BEK810331	48.7	0.2	1.7	49.4	-	-	-	-	-	-	-	-	-	-		285.1	287.0	289.2	291.5	293.7		37.2	21.7	14.3	12.1	14.7	1.21
Moldex 2740R95, layer 3	Y0BEK810341	95.0	2.5	2.5	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 2740R95, layer 6	Y0BEK810351	94.6	2.7	2.7	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 2740R95, layer 7	Y0BEK810361	94.2	3.0	2.9	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 2840R95, layer 3	Y0BEK810371	94.4	2.9	2.8	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 2840R95, layer 5	Y0BEK810381	94.4	2.9	2.8	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 2840R95, layer 8	Y0BEK810391	94.4	2.8	2.9	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 2741R95, layer 3	Y0BEK810401	94.3	2.9	2.8	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 2741R95, layer 4	Y0BEK810411	94.3	3.0	2.8	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 2741R95, layer 7	Y0BEK810421	94.6	2.7	2.7	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 2841R95, layer 3	Y0BEK810431	95.2	2.4	2.4	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 2841R95, layer 5	Y0BEK810441	94.8	2.7	2.6	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 2841R95, layer 8	Y0BEK810451	95.0	2.5	2.5	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 2940R95, layer 3	Y0BEK810461	95.5	2.2	2.3	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 2940R95, layer 5	Y0BEK810471	94.8	2.5	2.7	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 2940R95, layer 8	Y0BEK810481	94.8	2.6	2.7	0.0	-	-	-	-	-	-	-	-	-	-													
Sperian P1135 M/L, layer 3	Y0BEK810501	95.1	2.5	2.4	0.0	-	-	-	-	-	-	-	-	-	-													
Sperian P1135 M/L, layer 4	Y0BEK810511	95.3	2.4	2.4	0.0	-	-	-	-	-	-	-	-	-	-													
Sperian P1135 M/L, layer 6	Y0BEK810521	95.2	2.4	2.4	0.0	-	-	-	-	-	-	-	-	-	-													
Sperian P1115 M/L, layer 3	Y0BEK810531	94.1	3.0	2.9	0.0	-	-	-	-	-	-	-	-	-	-													
Sperian P1115 M/L, layer 4	Y0BEK810541	94.6	2.7	2.7	0.0	-	-	-	-	-	-	-	-	-	-													
Sperian P1115 M/L, layer 6	Y0BEK810551	94.6	2.8	2.6	0.0	-	-	-	-	-	-	-	-	-	-													
Sperian 1070, layer 2	Y0BEK810561	94.4	0.8	3.9	0.0	-	-	0.3	0.3	-	-	-	0.2	-	-													
Sperian 1070, layer 3	Y0BEK810571	97.8	0.6	1.6	0.0	-	-	0.0	0.0	-	-	-	0.0	-	-													
Sperian 105002-P100	Y0BEK810581	46.9	0.9	29.3	13.4	0.3	0.6	8.4	-	-	-	-	-	-	-		285.1	286.9	289.0	291.5	294.0		65.0	21.4	5.8	6.3	1.5	0.24
Moldex 8940 P100, layer 3	Y0BEK810591	95.8	0.8	3.4	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 8940 P100, layer 4	Y0BEK810601	97.9	0.7	1.4	0.0	-	-	-	-	-	-	-	-	-	-													
Moldex 8940 P100, layer 5	Y0BEK810611	97.4	0.7	1.9	0.0	-	-	-	-	-	-	-	-	-	-													
North 8145P95, layer 6	Y0BEK810621	96.0	1.7	2.4	0.0	-	-	-	-	-	-	-	-	-	-													
North 8145P95, layer 7	Y0BEK810631	93.0	3.6	3.4	0.0	-	-	-	-	-	-	-	-	-	-													
North 8145P95, layer 9	Y0BEK810641	93.2	3.5	3.3	0.0	-	-	-	-	-	-	-	-	-	-													
North 8140P95, layer 4	Y0BEK810651	92.2	3.6	3.8	0.0	-	-	0.3	-	-	-	-	-	-	-													
North 8140P95, layer 5	Y0BEK810661	93.1	3.6	3.3	0.0	-	-	-	-	-	-	-	-	-	-													
North 8140P95, layer 7	Y0BEK810671	92.8	3.8	3.4	0.0	-	-	-	-	-	-	-	-	-	-													
Sperian T108010, LP100	Y0BEK810681	40.2	1.7	21.4	27.6	0.2	-	7.9	-	-	1.0	-	-	-	-		285.3	286.6	288.6	291.6	294.0		62.7	9.4	6.7	18.3	2.8	0.15
MSA P/N N/P Ref. 815175	Y0BEK810691	14.6	0.3	59.4	0.1	4.4	2.2	17.9	-	-	-	0.3	0.5	0.3	-													
MSA Sparkfoe P100 P/N N/P Ref. 815176	Y0BEK810701	16.6	0.2	57.5	0.0	4.2	2.0	18.6	-	-	-	0.2	0.5	0.2	-													
Drager P100, Part Number 6737013	Y0BEK810901	26.7	-	48.6	0.0	0.4	1.2	22.6	-	-	-	-	0.3	-	0.1													
Drager Filter 882 FMP2 R D/P2 R/R95	Y0BEK810911	19.7	-	55.5	0.0	1.2	1.8	21.6	-	-	-	-	0.3	-	0.0													
3M 60921, white pleated mat	Y0BEK810921	43.2	-	12.9	40.5	-	-	3.5	-	-	-	-	-	-	-	283.9	285.1	286.5	289.0	291.6	293.8	8.5	40.8	15.4	7.4	24.2	3.7	0.15
3M 60921, white felt below mat	Y0BEK810931	100.0	-	-	0.0	-	-	-	-	-	-	-	-	-	-													
3M 60921, white felt at exit	Y0BEK810941	100.0	-	-	0.0	-	-	-	-	-	-	-	-	-	-													

3M 60923, white pleated mat	Y0BEK810951	41.7	1.1	33.3	13.1	0.4	-	10.4	-	-	-	-	-	-	-	283.8	284.9	286.4	288.5	291.5	293.7	7.2	52.2	23.5	8.3	7.0	1.9	0.27
3M 60923, white felt below mat	Y0BEK810961	100.0	-	-	0.0	-	-	-	-	-	-	-	-	-	-													
3M 60923, white felt at exit	Y0BEK810971	100.0	-	-	0.0	-	-	-	-	-	-	-	-	-	-													
MSA 815303/815369, white pleated mat	Y0BEK8109101	40.7	1.6	22.2	25.9	0.5	0.6	7.7	-	-	0.9	-	-	-	-	283.8	285.3	286.6	288.3	291.5	293.7	4.9	56.5	9.9	8.5	16.8	3.4	0.20
MSA 815300/815366, white pleated mat	Y0BEK8109111	37.3	1.5	26.1	23.4	0.6	0.6	9.5	-	-	0.9	-	-	-	-	283.7	285.1	286.4	288.5	291.4	293.7	5.3	51.8	15.8	8.0	15.2	3.8	0.25
MSA 815300/815366, white felt below pleated mat	Y0BEK8109121	67.5	10.3	20.4	0.0	0.2	-	-	0.3	0.9	0.3	-	-	-	-													
MSA 815300/815366, white felt at exit touching granule	Y0BEK8109131	68.2	9.1	20.8	0.0	0.4	-	-	0.4	0.9	0.2	-	-	-	-													
MSA 815300/815366, white felt at exit, outermost layer	Y0BEK8109141	67.6	10.3	20.3	0.0	0.2	-	-	0.4	0.9	0.3	-	-	-	-													
MSA 818354/818334, section 1, layer 2	Y0BEK8109151	98.0	0.2	1.8	0.0	-	-	-	-	-	-	-	-	-	-													
MSA 818354/818334, section 1, layer 3	Y0BEK8109161	93.0	3.8	3.2	0.0	-	-	-	-	-	-	-	-	-	-													
MSA 818354/818334, section 1, layer 5	Y0BEK8109171	93.1	3.6	3.3	0.0	-	-	-	-	-	-	-	-	-	-													
MSA 818354/818334, section 1, layer 6	Y0BEK8109181	93.1	3.6	3.3	0.0	-	-	-	-	-	-	-	-	-	-													
MSA 818354/818334, section 1, layer 8	Y0BEK8109191	99.9	0.0	0.1	0.0	-	-	-	-	-	-	-	-	-	-													
MSA 818354/818334, section 2, layer 2	Y0BEK8109201	99.4	0.3	0.3	0.0	-	-	-	-	-	-	-	-	-	-													
MSA 818354/818334, section 2, layer 4	Y0BEK8109213	93.8	3.3	2.9	0.0	-	-	-	-	-	-	-	-	-	-													
MSA 818354/818334, section 2, layer 5	Y0BEK8109221	93.0	3.8	3.2	0.0	-	-	-	-	-	-	-	-	-	-													
MSA 818354/818334, section 2, layer 7	Y0BEK8109231	93.0	3.7	3.3	0.0	-	-	-	-	-	-	-	-	-	-													

EXHIBIT C

Materials Considered

Depositions

Deposition of Brett Haskins. dated October 13, 2011

Deposition of John Huberty, dated September 28, 2011

Deposition of Kumar Ogale, dated March 8, 2011

Deposition of Kumar Ogale, dated July 22, 2011

Deposition of Kumar Ogale, dated October 10, 2011

Deposition of L. Clifton Dickerson, III, dated October 11, 2011

Deposition of Luis Bonilla, dated October 11, 2011

Deposition of Richard Granville, dated October 7, 2011

Deposition of Richard Wolfson, dated October 7, 2011

Deposition of Vaughn Grannis, dated November 29, 2011

Deposition of Vaughn Grannis, dated September 14, 2011

Court Documents, Opinions and Interrogatories

Second Amended Complaint and Jury Demand Transweb LLC v. 3M Innovative Properties Co and 3M Co, dated June 3, 2011

Opinion - Transweb LLC v. 3M Innovative Properties Co et al., dated June 1, 2011

Transweb, LLC v. 3M Innovative Properties Co. et al., Civ No. 10-4413 (GEB)(PS) TransWeb LLC's Inequitable Conduct Case Statement

Declaration of Vaughn Grannis in Support of Defendants' Opposition to Transweb LLC's Motion to Amend Complaint, dated May 2, 2011

Letter from Howard J. Cohen, Ph.D. CIH, to Michael Williams, December 16, 2011

Stipulation Regarding Expert Discovery And Proposed Order - TransWeb, LLC v. 3M Innovative Properties Company and 3M Company.

3M Innovative Properties Company And 3M Company's Answers To TransWeb's Fifth Set Of Interrogatories (Nos. 24-29)

3M Innovative Properties Company And 3M Company's Answers To TransWeb's First Set of Interrogatories (Nos. 1-9)

3M Innovative Properties Company And 3M Company's Answers To TransWeb's Fourth Set of Interrogatories Related To TransWeb's Second Amended Complaint (Nos. 14-23)

3M Innovative Properties Company And 3M Company's Answers To TransWeb's Second Set of Interrogatories (Nos. 10-11)

3M Innovative Properties Company And 3M Company's Answers To TransWeb's Third Set of Interrogatories (Nos. 12)

3M Innovative Properties Company And 3M Company's Answers To TransWeb's Third Set of Interrogatories (Nos. 12-13)

3M Innovative Properties Company And 3M Company's Second Supplemental Answers To TransWeb's Third Set of Interrogatories, No. 13

3M Innovative Properties Company And 3M Company's Supplemental Answers To TransWeb's First And Third Set Of Interrogatories, Nos. 3, 5 and 13

3M Innovative Properties Company And 3M Company's Supplemental Answers To TransWeb's First Set of Interrogatories, Nos. 7, 8, And 9

3M's Second Supplemental Answers To TransWeb's Fourth Set of Interrogatories Related To Its Second Amended Complaint (No. 15)

3M's Supplemental Answers To TransWeb's Fourth Set of Interrogatories Related To Its Second Amended Complaint

3M's Supplemental Answers To TransWeb's Fourth Set of Interrogatories Related To Its Second Amended Complaint

3M's Supplemental Answers To TransWeb's Fourth Set of Interrogatories Related To Its Second Amended Complaint (Nos. 18-19)

3M's Supplemental Answers To TransWeb's Interrogatory's Nos. 5, 17, 22, And 24

Plaintiff TransWeb, LLC's Second Supplemental And Amended Response To 3M's First Set Of Interrogatories To TransWeb (No. 11)

Supplemental Responses To 3M's First Set Of Interrogatories To TransWeb (No. 11).

Production Documents

3M0039981 - 993

3M0001041 - 42

3M0001060 - 61

3M0001652 - 655

3M0001658 - 661

3M0001697 - 1717

3M0001780 - 783

3M0001914 - 987

3M0002142

3M0002553 - 616

3M0002553 - 2557

3M0002675 - 2719

3M0002720 - 2764
3M0002765 - 2821
3M0002822 - 2889
3M0002890 - 2944
3M0002945 - 3005
3M0003006 - 3089
3M0003090 - 3114
3M0003115 - 3117
3M0003118 - 185
3M0003186 - 3239
3M0003240 - 3277
3M0003278 - 3315
3M0003316 - 3337
3M0003338 - 3351
3M0003352 - 3369
3M0003370 - 3444
3M0003445 - 3500
3M0003501 - 3568
3M0003677 - 3684
3M0015519
3M0016090 - 16110
3M0016232
3M0029824 - 9827
3M0030763 - 804
3M0030858 - 59
3M0030860 - 62
3M0033759 - 802
3M0034864 - 877
3M0034927 - 971
3M0034932 - 34
3M0034972 - 976
3M0035596 - 600
3M0035768 - 829
3M0035858 - 861
3M0035988 - 989
3M0036047 - 152
3M0036168 - 176
3M0036179 - 189
3M0036256 - 262

3M0036266 - 273
3M0036299 - 308
3M0036338 - 364
3M0036366 - 367
3M0036691 - 713
3M0036714 - 747
3M0036812 - 863
3M0036865 - 37413
3M0037554 - 576
3M0037600 - 623
3M0037774 - 785
3M0037788 - 799
3M0039059 - 062
3M0039063 - 083
3M0039181 - 188
3M0039190 - 210
3M0039220 - 221
3M0039226 - 249
3M0039296 - 324
3M0039474 - 494
3M0039676 - 677
3M0039726 - 738
3M0039744 - 758
3M0040032 - 053
3M0040167 - 178
3M0040320 - 335
3M0040438 - 453
3M0040890 - 915
3M0042078 - 104
3M0042210 - 220
3M0042237 - 247
3M0042249 - 259
3M0042274 - 290
3M0042300 - 358
3M0042387 - 389
3M0042390 - 393
3M0043329 - 348
3M0043649 - 650
3M0043951 - 963

3M0044078 - 102
3M0044104 - 127
3M0044129 - 153
3M0044155 - 173
3M0044201 - 210
3M0044270 - 318
3M0044750 - 773
3M0044810 - 836
3M0044868 - 871
3M0044872 - 903
3M0045010 - 095
3M0045097 - 128
3M0045134 - 138
3M0045139 - 170
3M0045202 - 233
3M0045235 - 266
3M0045312 - 343
3M0045452 - 485
3M0045509 - 542
3M0045545 - 578
3M0045606 - 639
3M0045641 - 679
3M0046620 - 666
3M0047692 - 702
3M0047765 - 842
3M0048937 - 9288
3M0049357 - 425
3M0049427 - 535
3M0049610 - 611
3M0051404 - 414
3M0052542 - 568
3M0053072 - 078
3M0053588 - 681
3M0053867 - 989
3M0054052 - 060
3M0056451 - 479
3M0056482 - 513
3M0056514 - 546
3M0056547 - 557

3M0056559 - 590
3M0056592 - 676
3M0056702 - 57921
3M0057924 - 955
3M0057964 - 995
3M0058093 -124
3M0058134 - 165
3M0058305 - 308
3M0058647 - 648
3M0058819 - 823
3M0059451 - 466
3M0059476 - 491
3M0059591 - 595
3M0059596 - 597
3M0059598 - 601
3M0059602 - 606
3M0060355 - 356
3M0060581 - 582
3M0063128 - 140
3M0065004 - 005
3M0065066 - 068
3M0065266 - 287
3M0065292 - 310
3M0065925
3M0065932 - 936
3M0065948 - 985
3M0066007 - 018
3M0066700 - 708
3M0066712 - 723
3M0066762
3M0066812 - 816
3M0067081 - 082
3M0067093 - 097
3M0068374 - 375
3M0068379 - 380
3M0068843 - 906
3M0070068 - 075
3M0070247 - 272
3M0070330 - 341

3M0070423 - 457
3M0070690 - 719
3M0070721 - 750
3M0071472 - 478
3M0072074 - 089
3M0072867 - 897
3M0072907 - 910
3M0074498 - 512
3M0074786 - 787
3M0074792 - 804
3M0074826 - 996
3M0075073
3M0080717 - 718
3M0080719 - 721
3M0080722 - 728
3M0080729 - 730
3M0080738
3M0081207
3M0081273 - 275
3M0081421 - 437
3M0081459
3M0081526 - 527
3M0081581 - 583
3M0083145 - 147
3M0083165 - 204
3M0087044
3M0087118
3M0031071.xlsx
3M0031078 Highly Confidential.xls
3M0031079 Highly Confidential.xls
3M0036865 Highly Confidential.xls
3M0037600 Highly Confidential.xls
3M0037788 Highly Confidential.xls
3M0039059 Highly Confidential.xls
3M0039063 Highly Confidential.xls
3M0039226 Highly Confidential.xls
3M0039296 Highly Confidential.xls
3M0040032 Highly Confidential.xls
3M0044202 Highly Confidential.xls

3M0044750 Highly Confidential.xls
3M0053588 Highly Confidential.xls
3M0080131_HIGHLY_CONFIDENTIAL.xls
3M0080132_HIGHLY_CONFIDENTIAL.xls
3M0080133_HIGHLY_CONFIDENTIAL.xls
3M0080134_HIGHLY_CONFIDENTIAL.xls
3M0080135_HIGHLY_CONFIDENTIAL.xlsx
3M0080136_HIGHLY_CONFIDENTIAL.xlsx
3M0080731_HIGHLY_CONFIDENTIAL.xlsx
3M0080732_HIGHLY_CONFIDENTIAL.xls
3M0080733_HIGHLY_CONFIDENTIAL.xlsx
3M0080734_HIGHLY_CONFIDENTIAL.xlsx
3M0080735_HIGHLY_CONFIDENTIAL.xlsx
3M0080738 Highly Confidential.xls
3M0080736_HIGHLY_CONFIDENTIAL.xls
3M0083145 Highly Confidential.xls
3M0083165 Highly Confidential.xls
3M 4479234_1_Depo Exhibit 199.xlsx
Excel version of TW0045965-80.xls
Excel version of TW0048538-89.xls
Excel version of TW0048590-659.xls
Excel version of TW0053503-4117.xls
Excel version of TW0054124-38.xls
Excel version of TW54151-55.xls
Excel_version_of_TW0045965-80.xls
Excel_version_of_TW0048538-89.xls
Excel_version_of_TW0053503-4117.xls
Excel_version_of_TW0054124-38.xls
3M0031072.pdf
3M0031073.pdf
3M0031074.pdf
3M0031075.pdf
3M0031076.pdf
3M0031077.pdf
3M0031078.pdf
3M0031079.pdf
3M0031080.pdf
3M0031081.pdf
3M0031082.pdf

3M0031083.pdf
3M0031084.pdf
NIOSH_P100_Approval_List[1].pdf
NIOSH_P95_Approval_List[1].pdf
NIOSH_R95_Approval_List[1].pdf
3M0081273 Highly Confidential.ppt
Grannis Exhibit 084
Grannis Exhibit 085
Grannis Exhibit 100
Grannis Exhibit 101
Grannis Exhibit 102
Grannis Exhibit 103
Grannis Exhibit 124
TW0000227
TW0045965 - 980
TW0048538 - 589
TW0053503 - 54117
TW0059098 - 99
TW0059100 - 05
TW0059106 - 09
TW0059110 - 22
TW0059123 - 34
TW0059135 - 42
TW0059143 - 50
TW0059151 - 54
TW0059155 - 67
TW0059168 - 90
TW0059191 - 223
TW0059224 - 57
TW0059258 - 93
TW0059294 - 321
TW0059322 - 52
TW0059353 - 77
TW0059378 - 407
TW0059408 - 45
TW0059446 - 76
TW0059477 - 80
TW0059481 - 88
TW0059489 - 96

TW0059497 - 511

Miscellaneous

Dennis W. Carlton and Jeffrey M. Perloff, Modern Industrial Organization, 4th ed., p. 93.

Federal Register; 42 CFR 84.

George W. Stocking and Willard F. Mueller, “The Cellophane Case and the New Competition”, The American Economic Review, Vol. 45, No. 1 (Mar., 1955), pp. 29-63.

Joseph Farrell and Carl Shapiro, "Antitrust Evaluation of Horizontal Mergers: An Economic Alternative to Market Definition", The B.E. Journal of Theoretical Economics, vol. 10, issue 1, 2010.

Richard H. Posner and Frank A. Easterbrook, Antitrust: Cases, Economic Notes and Other Materials, 2nd edition, pp. 349-354.

U.S. Department of Justice and the Federal Trade Commission, Horizontal Merger Guidelines, issued August 19, 2010, pp. 8 - 10.

Personal Protective Equipment: A Global Strategic Business Report, October 2010, Global Industry Analysts, Inc.

Closing Documents for the Consummation of the Transactions Contemplated by the Equity Purchase Agreement by and among Clarcor Inc., et al.

"The Power to Protect Your World, 3M Respirator Selection Guide." http://solutions.3m.com/wps/portal/3M/en_US/PPESafetySolutions/PPESafety/Resources/Tools/

Letter to Judge Patty Shwartz from Christine I. Gannon with Connell Foley LLP, Re: TransWeb, LLC v. 3M Innovative Properties Company, et al. Civil Action No. 10-4413 (FHS/PS).

http://www.osha.gov/pls/oshaweb/owadisp.show